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National Eutrophication Survey, Las Vegas, Nev

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Oct 76

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

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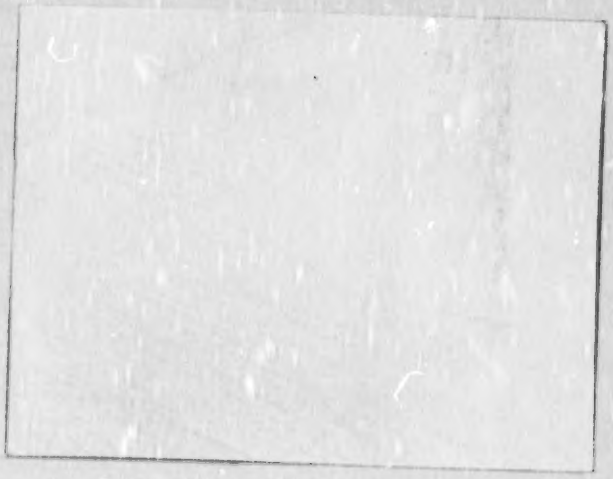

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REPORT
ON
LAKE LaMOURE
LaMOURE COUNTY
NORTH DAKOTA
EPA REGION VIII
WORKING PAPER No. 571

WITH THE COOPERATION OF THE
NORTH DAKOTA STATE DEPARTMENT OF HEALTH
AND THE
NORTH DAKOTA NATIONAL GUARD

OCTOBER, 1976

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Dakota State Department of Health for professional involvement, to the North Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those North Dakota wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

Norman L. Peterson, Director, and the staff of the Division of Water Supply and Pollution Control of the Department of Health, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

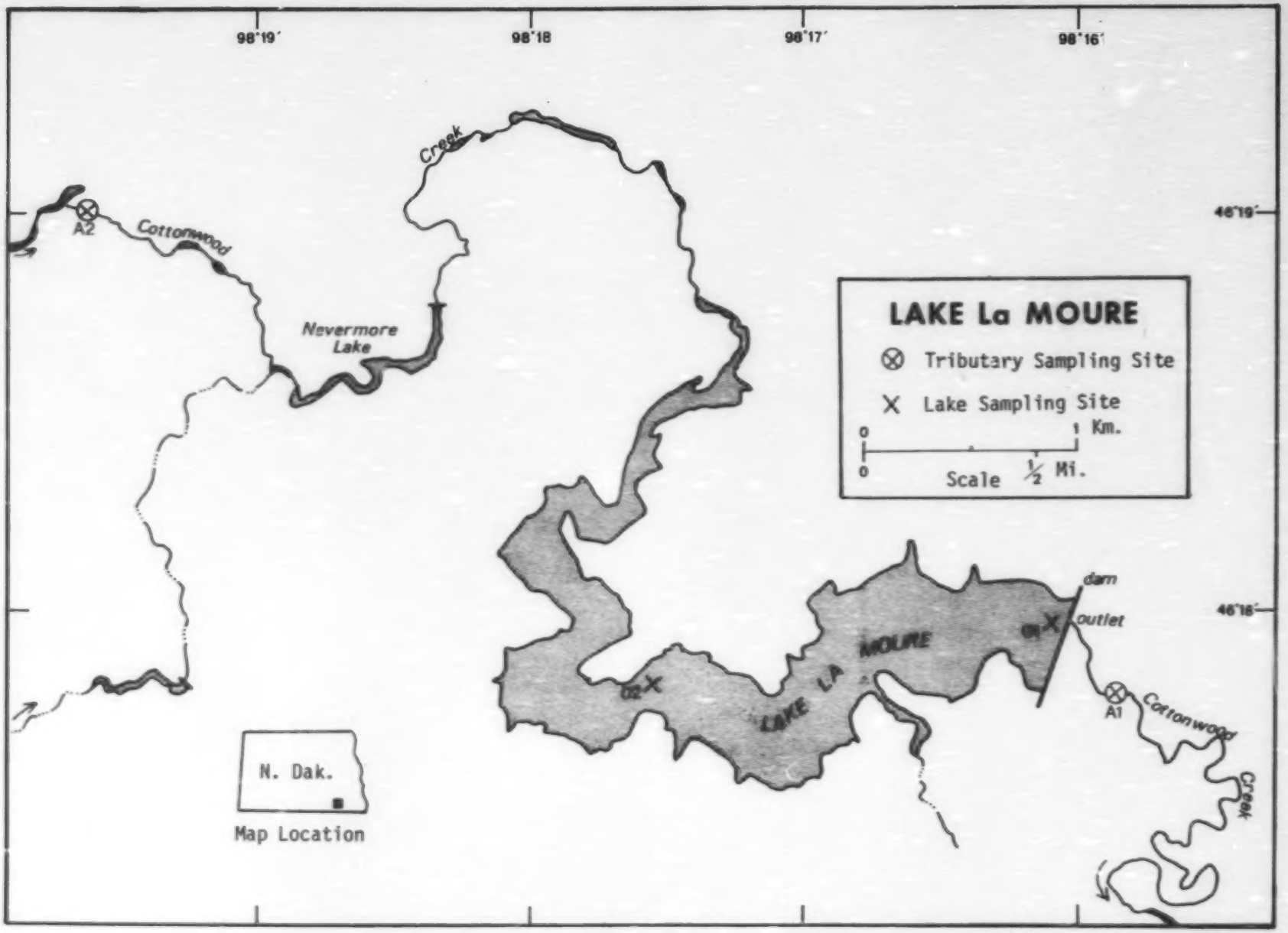
Major General LaClair A. Melhouse, the Adjutant General of North Dakota, and Project Officer Colonel Irvin M. Sande, who directed the volunteer efforts of the North Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

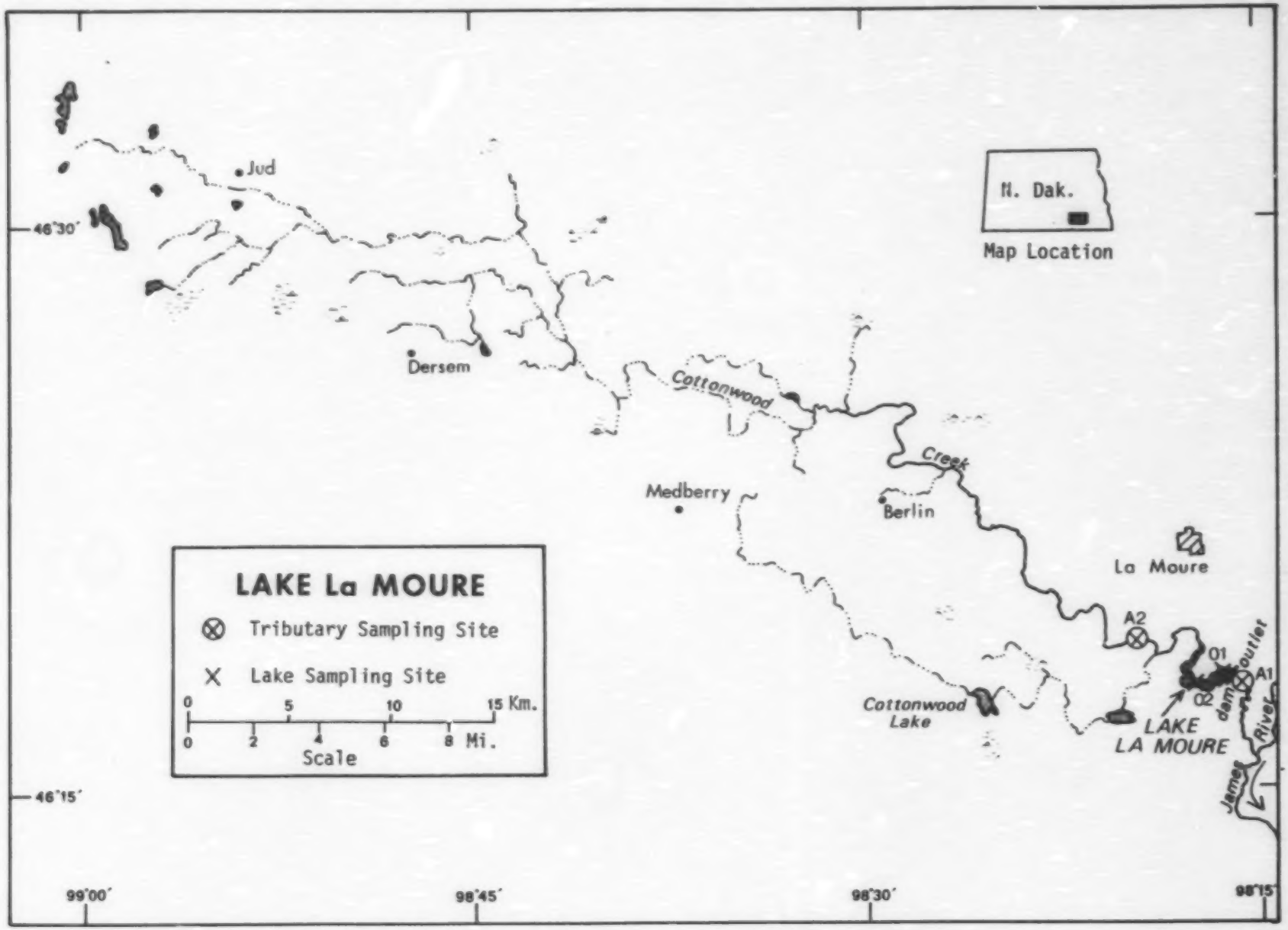
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF NORTH DAKOTA

NAME	COUNTY
Ashtabula	Barnes, Griggs
Audubon	McLean
Brush	McLean
Darling	Renville, Ward
Devils	Benson, Ramsey
Jamestown	Stutsman
LaMoure	LaMoure
Matejcek	Walsh
Metigoshe	Bottineau
Pelican	Bottineau
Sakakawea	Dunn, McKenzie, McLean, Mercer, Mountrail, Williams
Spiritwood	Stutsman
Sweet Briar	Morton
Whitman	Nelson, Walsh


98°19'
98°18
98°17'
98°16'
46°19'
46°18'
Creek
A2
Cottonwood
Nevermore
Lake
LAKE La MOURE
Tributary Sampling Site
Lake Sampling Site
0 1 Km.
0 Scale ½ Mi.
dam
outlet
01
02
LAKE LA MOURE
A1
Cottonwood
Creek
N. Dak.
Map Location


Jud
46°30'
Dersem
Cottonwood
Creek
Medberry
Berlin
La Moure
A2
01
02
A1
outlet
dam
Cottonwood
Lake
LAKE
LA MOURE
James
River
46°15'
99°00'
98°45'
98°30'
98°15'
N. Dak.
Map Location
LAKE La MOURE
Tributary Sampling Site
Lake Sampling Site
0 5 10 15 Km.
0 2 4 6 8 Mi.
Scale

LAKE LaMOURE

STORET NO. 3807

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake LaMoure is eutrophic. It ranked twelfth in overall trophic quality when the 14 North Dakota lakes sampled in 1974 were compared using a combination of six lake parameters*. Twelve of the lakes had less median total phosphorus, dissolved orthophosphorus, and inorganic nitrogen; six had less mean chlorophyll a; and four had greater mean Secchi disc transparency. Marked depression or depletion of dissolved oxygen with depth occurred at sampling station 1 in April and July.

Survey limnologists reported algal blooms and abundant submerged macrophytes in July and September.

B. Rate-Limiting Nutrient:

The algal assay results indicate that the lake was nitrogen limited in September. The lake data indicate nitrogen limitation at all sampling times.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Lake LaMoure during the sampling year.

2. Non-point sources--Non-point sources contributed the

* See Appendix A.

entire phosphorus loading to the lake during the sampling year. Cottonwood Creek was the major source and contributed about 93% of the phosphorus loading. Minor tributaries and immediate drainage contributed an estimated 6% of the loading.

The estimated phosphorus loading of 1.35 g/m^2/year is over four times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). A large reduction in this loading would be necessary to significantly improve the trophic condition of the lake. However, since much of the phosphorus load is the result of agricultural practices (Peterson, 1974), this may be difficult to achieve.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 2.0 kilometers^2.
2. Mean depth: 5.0 meters.
3. Maximum depth: 12.2 meters.
4. Volume: 9.962×10^6 m^3.
5. Mean hydraulic retention time: 1.9 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Cottonwood Creek	334.1	0.171
Minor tributaries & immediate drainage -	21.3	0.011
Totals	355.4	0.182

2. Outlet -

Cottonwood Creek	357.4**	0.165

C. Precipitation***:

1. Year of sampling: 66.5 centimeters.
2. Mean annual: 53.5 centimeters.

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† Table of metric conversions--Appendix B.
†† Hoetzer, 1976.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Lake LaMoure was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Except for the first time, samples for physical and chemical parameters were collected from two or more depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 6.7 meters at station 1 and 0.9 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE LA MOURE
STORET CODE 3807

	1ST SAMPLING (4/29/74) 1 SITES			2ND SAMPLING (7/10/74) 2 SITES			3RD SAMPLING (9/17/74) 2 SITES		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	14.0 - 14.0	14.0	14.0	15.4 - 27.2	23.3	23.7	14.9 - 15.6	15.2	15.3
DISS OXY (MG/L)	7.6 - 8.0	7.8	7.8	0.0 - 6.2	2.4	1.2	6.2 - 9.0	7.4	7.2
CNDCTVY (MCROMO)	333. - 335.	334.	334.	552. - 733.	664.	663.	607. - 610.	608.	608.
PH (STAND UNITS)	7.8 - 7.8	7.8	7.8	7.7 - 8.4	8.1	8.0	7.6 - 7.7	7.6	7.6
TOT ALK (MG/L)	128. - 132.	130.	131.	238. - 290.	261.	264.	395. - 515.	466.	480.
TOT P (MG/L)	0.129 - 0.147	0.136	0.131	0.459 - 1.380	0.628	0.478	0.361 - 0.438	0.398	0.387
ORTHO P (MG/L)	0.032 - 0.035	0.033	0.033	0.357 - 0.868	0.468	0.393	0.245 - 0.292	0.272	0.284
NO2+NO3 (MG/L)	0.020 - 0.180	0.087	0.060	0.070 - 0.160	0.095	0.080	0.070 - 0.080	0.078	0.080
AMMONIA (MG/L)	0.030 - 0.060	0.043	0.040	0.220 - 2.170	0.612	0.325	0.290 - 0.340	0.310	0.300
KJEL N (MG/L)	1.400 - 1.600	1.500	1.500	1.600 - 3.300	2.083	1.850	2.400 - 3.690	2.840	2.700
INORG N (MG/L)	0.050 - 0.240	0.130	0.100	0.290 - 2.330	0.707	0.415	0.370 - 0.410	0.388	0.380
TOTAL N (MG/L)	1.460 - 1.780	1.587	1.520	1.680 - 3.460	2.178	1.940	2.480 - 3.680	2.918	2.770
CHLRPYL A (UG/L)	8.6 - 8.6	8.6	8.6	2.6 - 25.5	14.0	14.0	22.7 - 39.2	30.9	30.9
SECCHI (METERS)	0.8 - 0.8	0.8	0.8	1.8 - 3.7	2.7	2.7	1.8 - 1.8	1.8	1.8

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/29/74	1. Cyclotella sp.	5,208
	2. Ankistrodesmus sp.	2,559
	3. Synedra sp.	1,594
	4. Chroomonas sp.	353
	5. Cryptomonas sp.	539
	Other genera	1,055
	Total	11,808
07/10/74	1. Rhodomonas sp.	1,772
	2. Cryptomonas sp.	405
	3. Aphanizomenon sp.	354
	4. Anabaena sp.	101
	5. Ankistrodesmus sp.	51
	Other genera	152
	Total	2,835
09/17/74	1. Aphanizomenon sp.	2,402
	2. Chroomonas sp.	129
	3. Cryptomonas sp.	43
	Total	2,574

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/29/74	1	8.6
	2	-
07/10/74	1	2.6
	2	25.5
09/17/74	1	39.2
	2	22.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.290	0.646	18.5
0.050 P	0.340	0.646	19.0
0.050 P + 1.0 N	0.340	1.646	43.0
1.0 N	0.290	1.646	43.7

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake LaMoure was high at the time the assay sample was collected (09/17/74). Also, the significant increase in yield with the addition of nitrogen alone indicates that the lake was limited by nitrogen at that time. Note that the addition of phosphorus alone did not result in a significant increase in yield.

The lake data also indicate nitrogen limitation; i.e.; the mean inorganic nitrogen/orthophosphorus ratios were 4/1 or less at all sampling times.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, when possible the North Dakota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff month of May when two samples were collected. Sampling was begun in March, 1975, and was completed in August, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the North Dakota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station A-2, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

* See Working Paper No. 175.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Cottonwood Creek	2,505	93.1
b. Minor tributaries & immediate drainage (non-point load) -	150	5.6
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	35	1.3
Total	2,690	100.0

2. Outputs -

Lake outlet - Cottonwood Creek 1,580

3. Net annual P accumulation - 1,110 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Cottonwood Creek	7,695	74.4
b. Minor tributaries & immediate drainage (non-point load) -	490	4.7
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	2,160	20.9
Total	10,345	100.0

2. Outputs -

Lake outlet - Cottonwood Creek 9,040

3. Net annual N accumulation - 1,305 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Cottonwood Creek	7	23

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	1.35	0.56	5.2	0.7

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake LaMoure:	
"Dangerous" (eutrophic loading)	0.32
"Permissible" (oligotrophic loading)	0.16

V. LITERATURE REVIEWED

Hoetzer, Steve, 1976. Personal communication (lake morphometry). ND State Water Comm., Bismarck.

Peterson, Norman L., 1974. Personal communication (nutrient sources in the Lake LaMoure drainage basin). ND Dept. of Health, Bismarck.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3801	LAKE ASHTABULA	0.260	0.160	472.250	40.892	10.600	0.170
3802	LAKE AUDUBON	0.087	0.220	446.222	11.322	11.000	0.015
3803	BRUSH LAKE	0.066	0.095	449.143	29.114	9.000	0.010
3804	LAKE DARLING	0.274	0.250	466.750	60.075	11.600	0.180
3805	DEVILS LAKE	0.630	0.140	449.333	38.508	14.600	0.469
3806	JAMESTOWN RESERVOIR	0.144	0.365	438.667	19.400	8.800	0.078
3807	LAKE LA MOURE	0.438	0.380	421.400	19.720	15.000	0.290
3808	MATEJCEK LAKE	0.228	0.440	475.167	2.683	14.400	0.179
3809	LAKE METIGOSHE	0.032	0.080	389.167	10.367	9.000	0.010
3811	PELICAN LAKE	0.034	0.070	364.500	10.950	12.800	0.006
3812	LAKE SAKAKAWEA (GARRISON	0.016	0.150	408.733	6.883	10.800	0.007
3813	SPIRIT WOOD LAKE	0.156	0.290	417.833	34.667	15.000	0.082
3814	SWEET BRIAR RESERVOIR	0.092	0.090	440.800	39.000	8.800	0.031
3815	WHITMAN LAKE	0.260	0.260	478.333	27.067	9.200	0.185

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3801	LAKE ASHTABULA	27 (3)	54 (7)	15 (2)	8 (1)	62 (8)	38 (5)	204
3802	LAKE AUDUBON	69 (9)	46 (6)	46 (6)	69 (9)	46 (6)	69 (9)	345
3803	BRUSH LAKE	77 (10)	77 (10)	38 (5)	38 (5)	81 (10)	81 (10)	392
3804	LAKE DARLING	15 (2)	38 (5)	23 (3)	0 (0)	38 (5)	23 (3)	137
3805	DEVILS LAKE	0 (0)	69 (9)	31 (4)	23 (3)	15 (2)	0 (0)	138
3806	JAMESTOWN RESERVOIR	54 (7)	15 (2)	62 (8)	62 (8)	96 (12)	54 (7)	343
3807	LAKE LA MOURE	8 (1)	8 (1)	69 (9)	54 (7)	4 (0)	8 (1)	151
3808	MATEJCEK LAKE	38 (5)	0 (0)	8 (1)	100 (13)	23 (3)	31 (4)	200
3809	LAKE METIGOSHE	92 (12)	92 (12)	92 (12)	85 (11)	81 (10)	81 (10)	523
3811	PELICAN LAKE	85 (11)	100 (13)	100 (13)	77 (10)	31 (4)	100 (13)	493
3812	LAKE SAKAKAWEA (GARRISON	100 (13)	62 (8)	85 (11)	92 (12)	54 (7)	92 (12)	485
3813	SPIRIT WOOD LAKE	46 (6)	23 (3)	77 (10)	31 (4)	4 (0)	46 (6)	227
3814	SWEET BRIAR RESERVOIR	62 (8)	85 (11)	54 (7)	15 (2)	96 (12)	62 (8)	374
3815	WHITMAN LAKE	27 (3)	31 (4)	0 (0)	46 (6)	69 (9)	15 (2)	188

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3809	LAKE METIGOSHE	523
2	3811	PELICAN LAKE	443
3	3812	LAKE SAKAKAWEA (GARRISON	485
4	3803	BRUSH LAKE	392
5	3814	SWEET BRIAR RESERVOIR	374
6	3802	LAKE AUDUBON	345
7	3806	JAMESTOWN RESERVOIR	343
8	3813	SPIRIT WOOD LAKE	227
9	3801	LAKE ASHTABULA	204
10	3808	MATEJCEK LAKE	200
11	3815	WHITMAN LAKE	188
12	3807	LAKE LA MOURE	151
13	3805	DEVILS LAKE	138
14	3804	LAKE DARLING	137

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NORTH DAKOTA 03/16/76

LAKE CODE 3807 LAKE LAMOURE RES.

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 357.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3807A1	357.4	0.008	0.008	0.283	0.906	0.340	0.198	0.113	0.042	0.023	0.023	0.025	0.014	0.165
3807A2	334.1	0.008	0.008	0.283	0.906	0.340	0.227	0.142	0.048	0.028	0.025	0.025	0.014	0.171
3807ZZ	23.3	0.0	0.0	0.020	0.057	0.023	0.014	0.008	0.003	0.003	0.0	0.0	0.0	0.011

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 357.4
SUM OF SUB-DRAINAGE AREAS = 357.4

TOTAL FLOW IN = 2.18
TOTAL FLOW OUT = 1.99

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3807A1	9	74	0.0	21	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	18	0.0				
	12	74	0.0	21	0.0				
	1	75	0.0	18	0.0				
	2	75	0.0						
	3	75	0.0	21	0.0				
	4	75	1.331	5	0.0	18	5.663		
	5	75	0.040	2	0.054	17	0.011		
	6	75	0.119	22	0.028				
	7	75	2.945	19	0.595				
	8	75	0.042	22	0.020				
3807A2	9	74	0.0	21	0.0				
	10	74	0.0	19	0.0				
	11	74	0.0	18	0.0				
	12	74	0.0	21	0.0				
	1	75	0.0	18	0.0				
	2	75	0.0						
	3	75	0.0	21	0.0				
	4	75	0.396	5	0.0	18	0.000		
	5	75	0.054	2	0.085	17	0.014		
	6	75	0.023	22	0.023				
	7	75	2.775	19	0.708				
	8	75	0.054	22	0.020				
3807ZZ	9	74	0.0						
	10	74	0.0						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.085						
	5	75	0.003						
	6	75	0.008						
	7	75	0.193						
	8	75	0.003						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/03/16

380701
46 17 52.0 098 16 01.0 3
LAKE LA MOURE
38045 NORTH DAKOTA

11EPALES 2111202
0015 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 N02&N03 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/29	09 40	0000	14.0		33	335	7.85	132	0.060	1.600	0.180	0.032
	09 40	0005	14.0	8.0		334	7.80	128	0.030	1.500	0.020	0.033
	09 40	0010	14.0	7.6		333	7.80	131	0.040	1.400	0.060	0.035
74/07/10	13 05	0000	23.8	1.2	144	666	8.10	240	0.310	1.800	0.080	0.369
	13 05	0005	23.6	1.2		660	8.00	238	0.340	1.900	0.100	0.394
	13 05	0015	23.0	0.2		646	7.90	268	0.410	2.100	0.080	0.430
	13 05	0022	15.4	0.0		552	7.70	290	2.170	3.300	0.160	0.868
74/09/17	10 30	0000	15.6	9.0	72	607	7.63	480	0.300	3.100	0.080	0.288
	10 30	0005	15.5	8.0		610	7.66	485	0.300	3.600	0.080	0.292
	10 30	0011	15.3	7.2		608	7.58	455	0.340	2.700	0.070	0.284

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/29	09 40	0000	0.147	8.6	
	09 40	0005	0.131		
	09 40	0010	0.129		
74/07/10	13 05	0000	0.459	2.6	
	13 05	0005	0.490		
	13 05	0015	0.511		
	13 05	0022	1.380		
74/09/17	10 30	0000	0.438	39.2	
	10 30	0005	0.438		
	10 30	0008			10.0
	10 30	0011	0.387		

STORET RETRIEVAL DATE 76/03/16

380702
46 17 49.0 098 17 31.0 3
LAKE LA MOURE
38045 NORTH DAKOTA

11EPALES 2111202
0006 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/07/10	12 45	0000	27.2	6.2	72	726	8.40	270	0.220	1.800	0.070	0.393
	12 45	0003	27.1	5.6		733	8.40	260	0.220	1.600	0.080	0.357
74/09/17	10 15	0000	14.9	6.4	72	608	7.58	395	0.320	2.400	0.080	0.245
	10 15	0003	14.9	6.2		608	7.60	515	0.290	2.400	0.080	0.249

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/07/10	12 45	0000	0.467	25.5	
	12 45	0003	0.459		
74/09/17	10 15	0000	0.365	22.7	
	10 15	0003	0.361		
	10 15	0006			20.0

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/03/18

3807A1
46 17 45.0 098 45 50.0 4
COTTONWOOD CREEK
38093 7.5 LA MOURE
O/LAMOURE RESERVOIR
BRDG ON FAS 243 5 MI SE JCT WTH LA MOURE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/04/18	10 20		0.155	0.800	0.045	0.100	0.140
75/05/02	10 40		0.780	2.300	0.390	0.270	0.440
75/05/17	10 00		0.790	2.600	0.270	0.250	0.290
75/06/22	15 15		0.375	1.850	0.130	0.330	0.400
75/07/19	09 30		0.020	1.700	0.035	0.340	0.400
75/08/22	14 00		0.110	2.100	0.135	0.400	0.560

STORET RETRIEVAL DATE 76/03/18

3807A2
46 19 00.0 098 19 35.0 4
COTTONWOOD CREEK
38 7.5 LA MOURE
T/LA MOURE RESERVOIR
BRDG ON FAS 593 3.2 MI SW OF LA MOURE
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/03/21	13 30		0.510	2.800	0.775	0.345	0.810
75/04/18	10 35		0.360	6.050	1.950	0.420	0.610
75/05/02	11 00		1.050	1.650	0.045	0.120	0.260
75/05/17	10 28		0.010	1.600	0.040	0.170	0.200
75/06/22	15 45		0.070	1.600	0.125	0.430	0.540
75/07/19	09 45		0.010	1.350	0.040	0.575	0.600
75/08/22	14 15		0.010	1.950	0.040	0.875	0.960